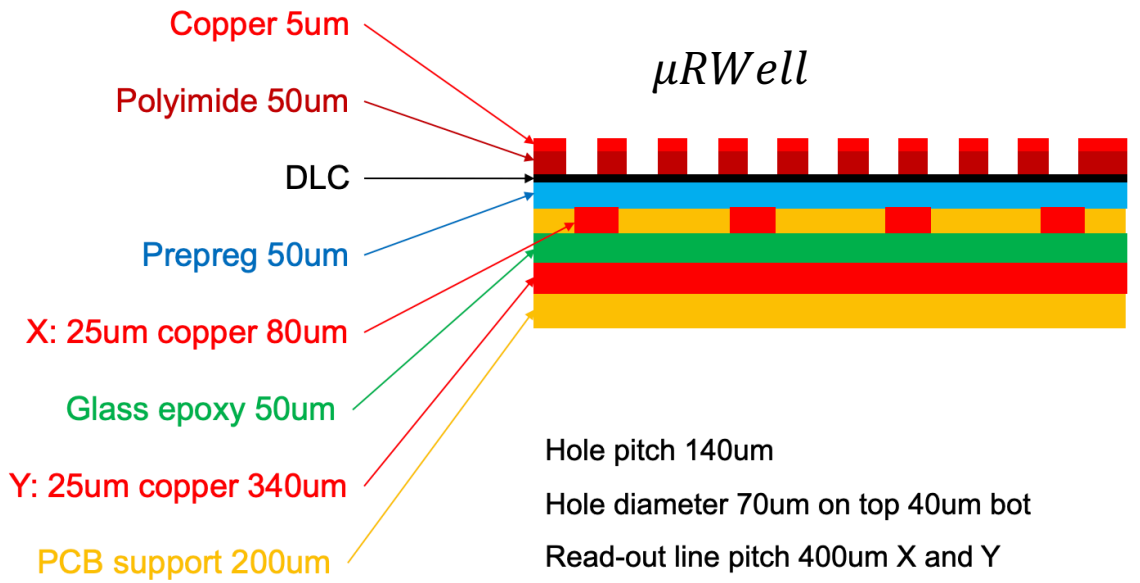
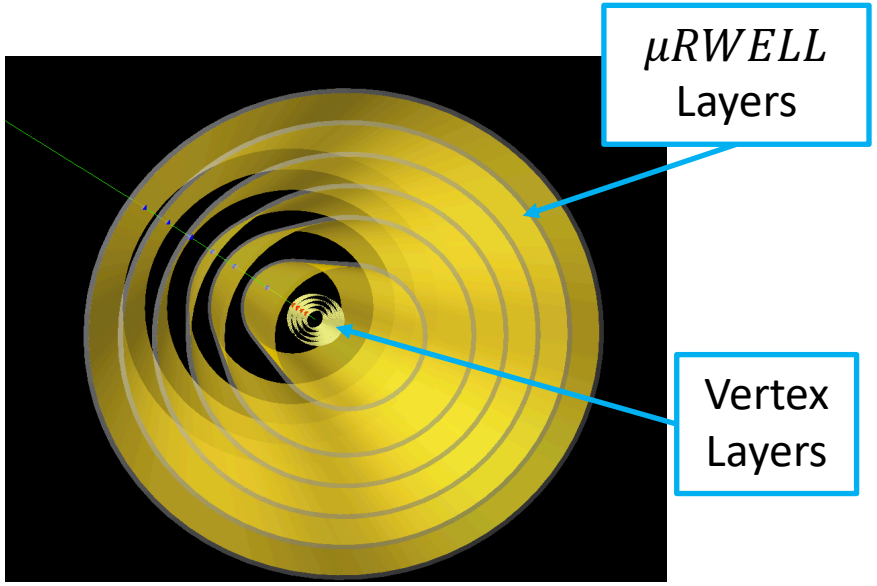
Central Tracking: Cylindrical μRWELL @ TU

- Cylindrical $\mu RWell$ simulation overview
  - TU graduate student Nick Lukow has taken over the bulk of the simulation work.
  - Investigate central tracking performance with silicon vertex detector and cylindrical $\mu RWell$ layers in a 1.5 T field.
  - Silicon vertex detector
    - 4 layers each with X-Y pixel resolution of 20 μm - 20 μm



- Detectors
  - **Silicon vertex detector**
    - 4 layers each with X-Y pixel resolution of 20 μm - 20 μm
  - **Cylindrical $\mu RWell$ Barrel Tracker**
    - Consists of six 2m long cylindrical layers covering radii from 22.5 cm-77.5 cm
    - For each layer
      - One hit point with resolution of ~100 μm (longitudinal) x ~100 μm (transverse)
      - Detector material , $\chi_0/\chi = 0.64\%$
      - Additional 15 mm of $ArCO_2$ implemented as drift gap



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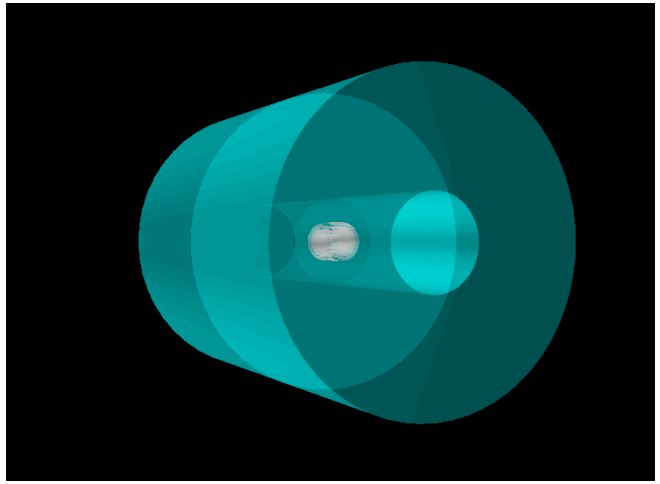
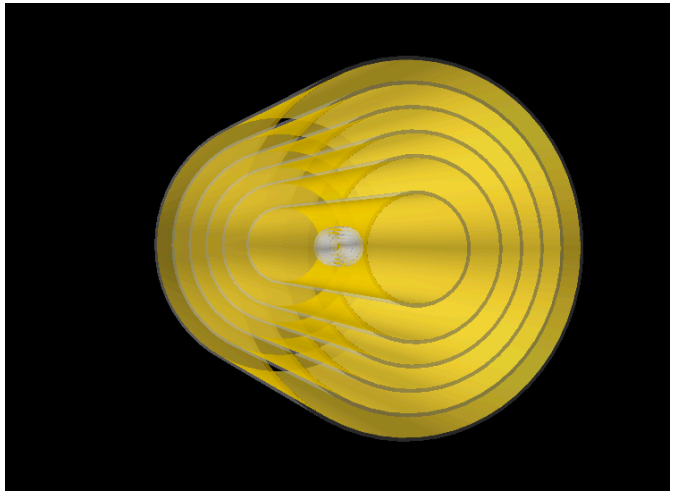
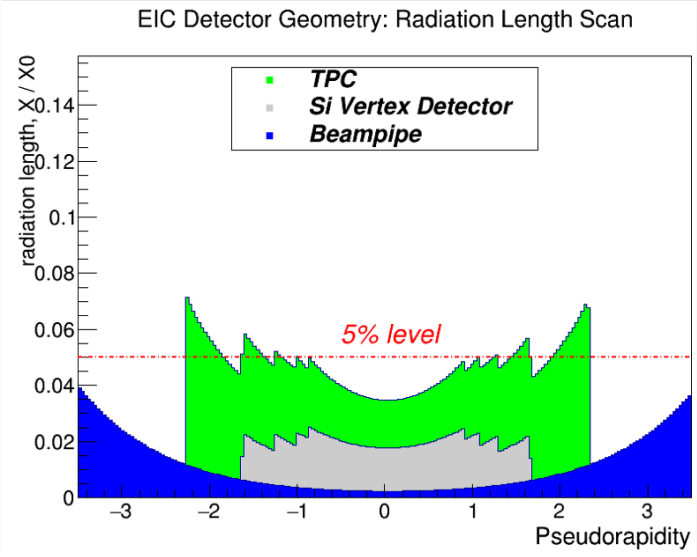
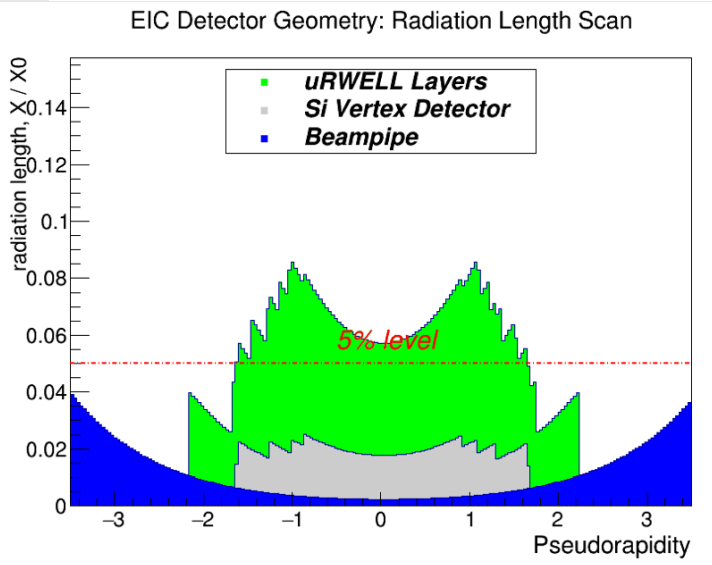
- Comparison to TPC performance
  - Implemented a TPC into simulation based on sPHENIX TPC
  - TPC parameters
    - Radial length: 80 cm
    - Dispersion (longitudinal, transverse)
      - ($1\ \mu m/\sqrt{D}$, $15\ \mu m/\sqrt{D}$)
    - Resolution (longitudinal, transverse)
      - ($500\ \mu m$, $200\ \mu m$)
  - Transverse dispersion and resolution need to be updated to match sPHENIX transverse (dispersion, resolution) beam test results ($40\ \mu m/\sqrt{D}$, $90\ \mu m$)
    - We do find particular sensitivity to the transverse dispersion
  - Material scan shows the TPC having less material overall than the current 6 cylindrical $\mu RWell$ barrel.









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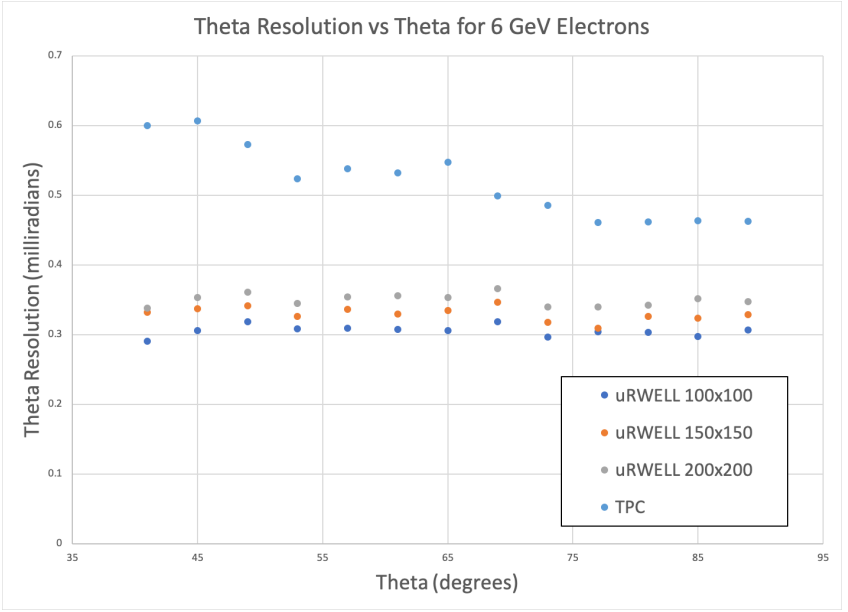
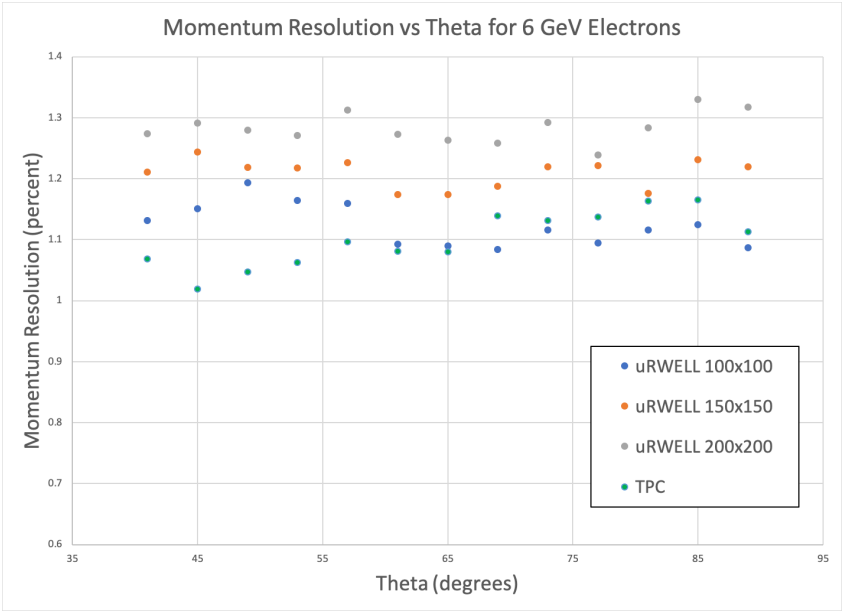
- Comparison of $\mu RWell$ and TPC performance
  - Performance of cylindrical $\mu RWell$ barrel was done using three (longitudinal, transverse) spatial resolution values
    - (100 μm, 100 μm), (150 μm, 150 μm), and (200 μm, 200 μm)
  - Using the stated detector simulation conditions, 6 GeV electrons were simulated in a 1.5 T magnetic field
  - Theta resolution vs. theta
    - $\mu RWell$ appears to have a better angular resolution than the TPC, particularly at smaller angle ($\sim 45^o$).
  - Momentum resolution vs. theta
    - TPC appears to have a better momentum resolution at small angle ($\sim 45^o$).
    - Momentum resolution of the $\mu RWell$ with resolution (100 μm, 100 μm) becomes comparable to the TPC at moderate angles ($> 55^o$)

Results include the vertex detector





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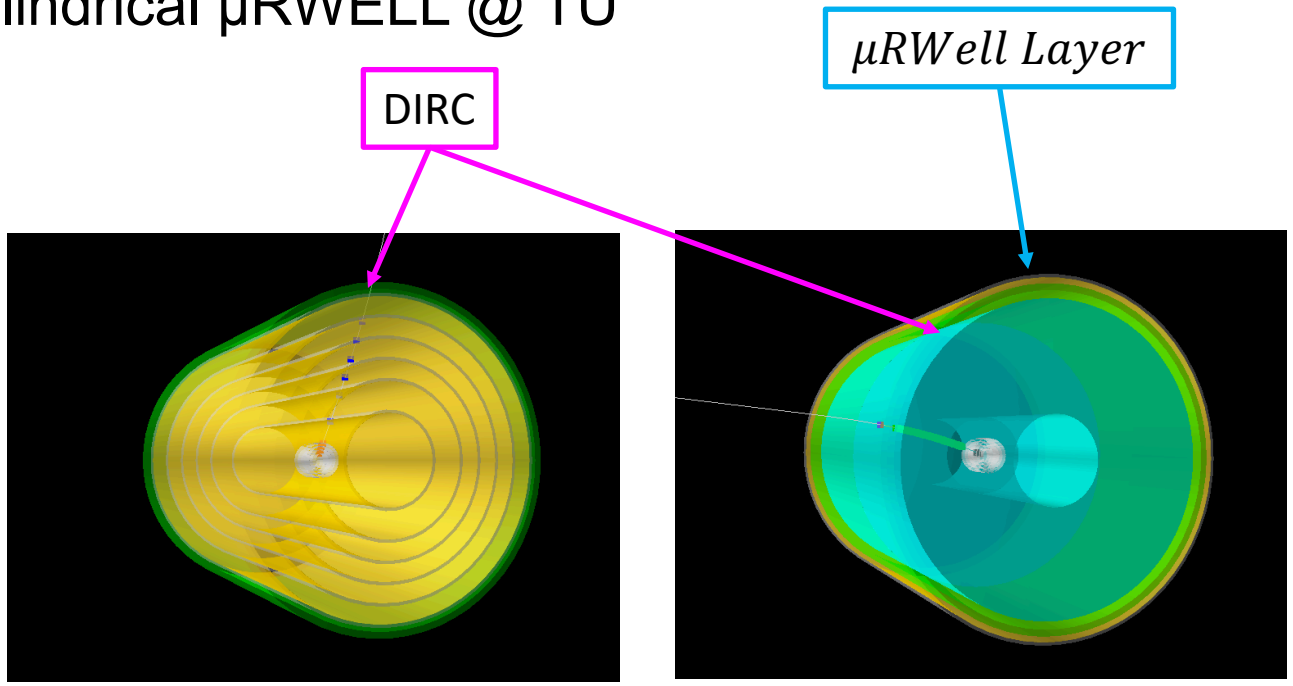
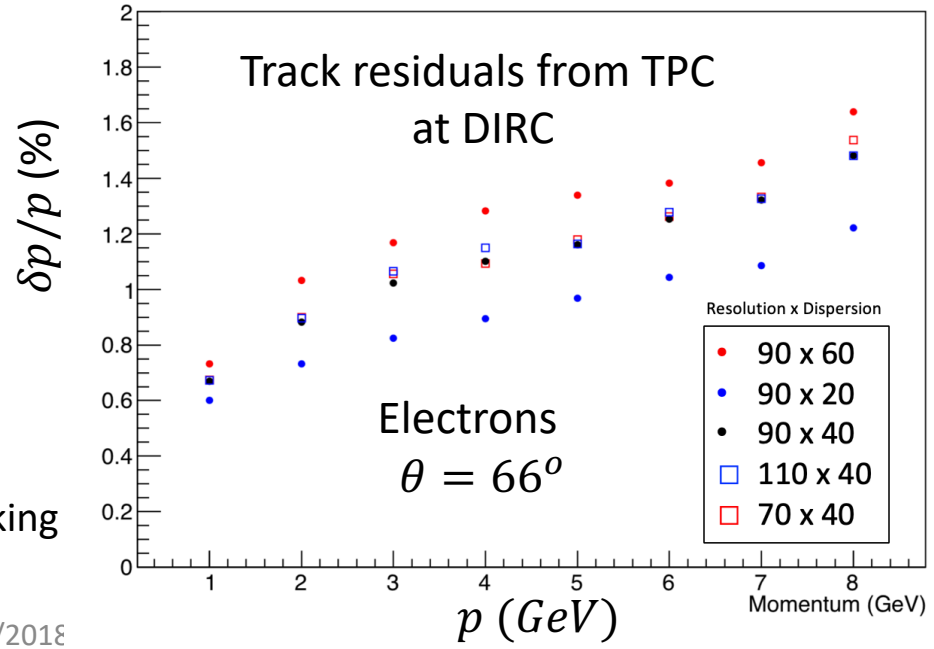
- Recent Progress
  - We have had several conversations with DIRC representatives from the PID consortium to better understand their tracking needs.
  - Added dead material representing the DIRC
    - Radial length: 80 cm, thickness 6 cm, $\chi_0/\chi = 17.5\%$
  - Track residuals at the DIRC show large sensitivity to TPC transverse dispersion.
  - Begun investigating tracking performance with additional $\mu RWell$ layer surrounding
    - The DIRC in both cylindrical $\mu RWell$ barrel and TPC configurations
    - Only the TPC

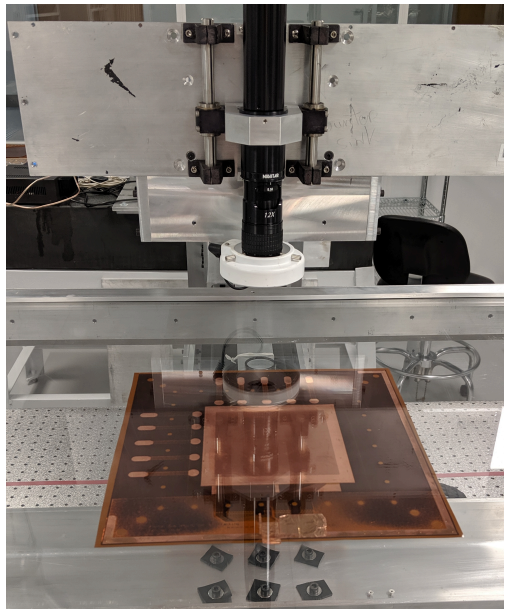


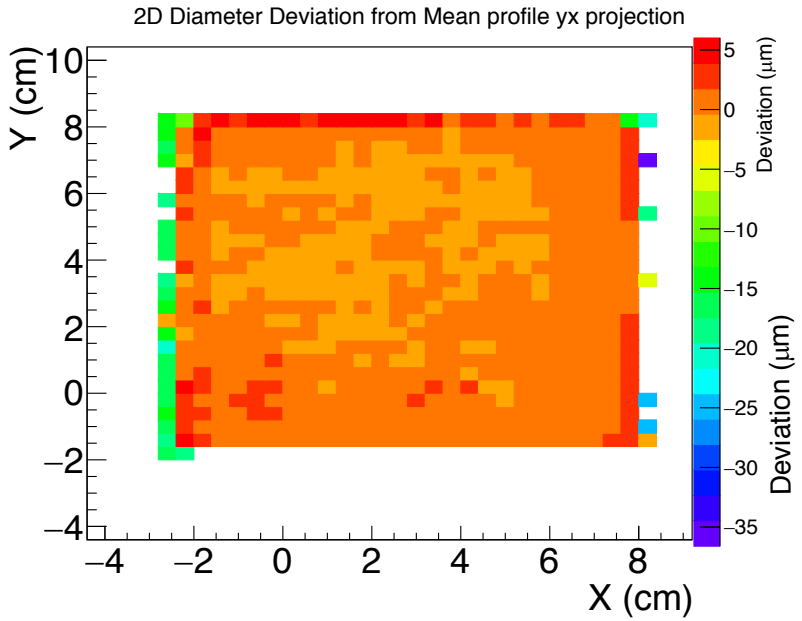
- Next steps for simulation work
  - ***μRWell***
    - Include multiple hit points and μTPC (mini-drift) mode
    - Optimize number of cylindrical layers and their spacing
    - Implement FIT support structure
  - **TPC**
    - Update simulations using measured sPHENIX transverse resolution
    - Investigate performance with $\mu RWell$ layer surrounding TPC
  - **DIRC**
    - Continue discussions with PID consortium (DIRC) to understand needed tracking performance
    - Implement realistic budget material



End Cap Tracking: Commercial GEMs @ TU

- GEM CCD Scanner
  - Continues to serve the MPGD community
  - Recently completed or upcoming scans
    - $\mu RWell$ foil (completed last summer)
    - Low Temperature Co-fired Ceramic GEM (to start soon)
  - Recently (this past summer) we completed scans of an FIT $\mu RWell$ foil that was deemed "bad" by CERN.





- $\mu RWell$ Foil Scan
  - Investigate hole (well) pitch and diameter uniformity of a $\mu RWell$.
  - FIT sent us a bare foil not mounted to a substrate that CERN determined to be "bad".
  - Measurements of the pitch and outer hole (well) diameters were found to be uniform.
    - Pitch: $\sim 138\ \mu m$
    - Outer well diameter deviation: $\sim 3\mu m$